5200

PROGRESS REPORT No. 7

On

COOPERATIVE RESEARCH ON CONTROL OF THE MOUNTAIN PINE BEETLE IN WESTERN WHITE PINE

March 18, 1971

By

BARK BEETLE COMMITTEE*

MONTANA-NORTHERN IDAHO FOREST PEST ACTION COUNCIL

(P. O. Box 1016, Lewiston, Idaho 83501)

Of

WESTERN FOREST PEST COMMITTEE

Of

WESTERN FORESTRY AND CONSERVATION ASSOCIATION

(Founded 1909)

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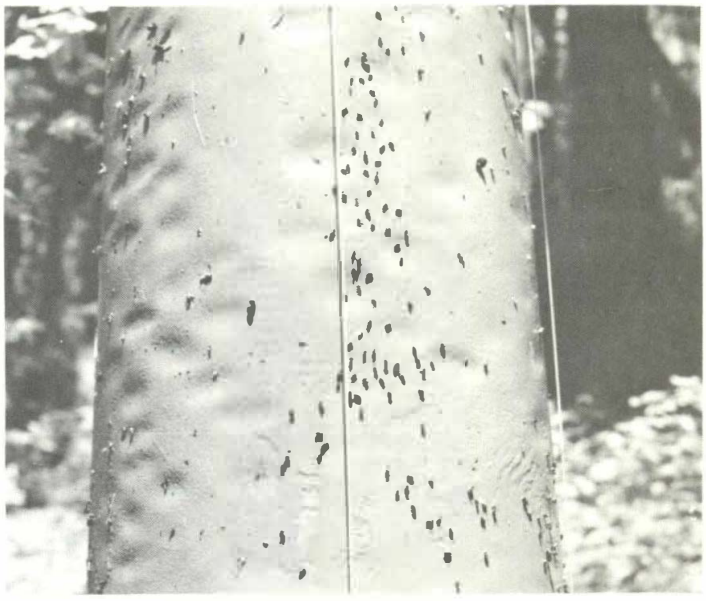
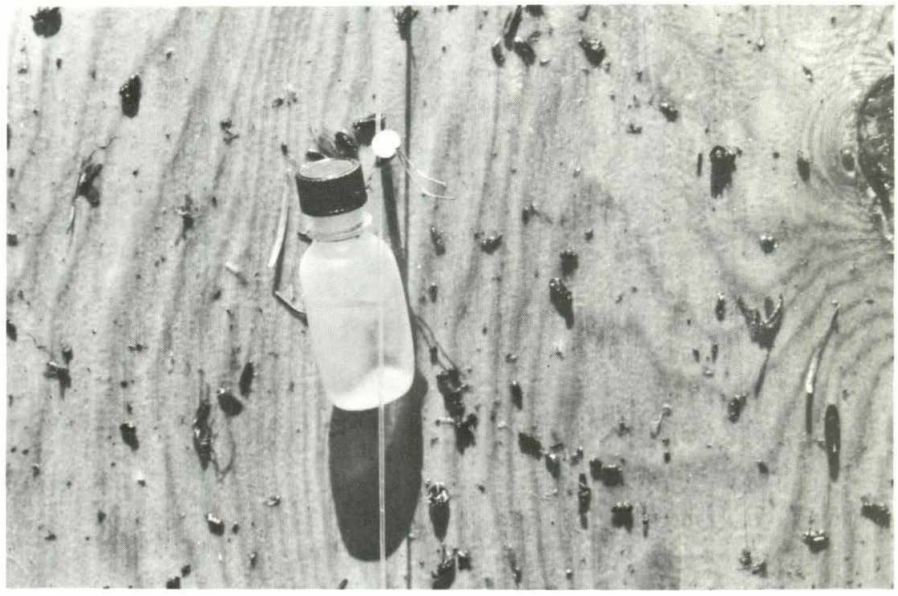
1970 STICKY TRAP TEST

1. 1'x5' paperboard cylinder coated with sticky compound and baited with trans-verbenol in plastic tubing and alpha pinene in bottles.



2. Close-up of mountain pine beetles attracted to cylinder trap and caught in non-toxic "Stikem Special". Beetles are approximately 3/16" long.

3. 1'x4' plywood panel traps treated same as in photo #1.



4. Close-up of beetles attracted to and caught on plywood trap.

BARK BEETLE COMMITTEE

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P. O. Box 1016, Lewiston, Idaho 83501
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Cooperative Mountain Pine Beetle Control Research Project

PROGRESS REPORT #7

This report reviews and condenses results of research to attempt to develop new methods of controlling the mountain pine beetle (Dendroctonus ponderosae) in white pine in northern Idaho.

ACKNOWLEDGEMENTS

The author is indebted to a number of people who submitted reports on various aspects of the project, i.e.: The Phase I entry is largely a slightly edited report by Dr. Gary B. Pitman, leader of the Grass Valley Laboratory of Boyce Thompson Institute for Plant Research and principal director of this cooperative project. Some of Phase I is from a report by Glenn W. Kinzer, senior chemist, Battelle Memorial Institute, Columbus, Ohio. The balance is based on reports from Larry French, BTI forest technician and leader of the Idaho forest phases of the project; Vernon S. Robinson, research forester for Potlatch Forests, Inc.; Garry B. Ringold, assistant managing forester, PFI; Paul W. Huffman, PFI forest inventory supervisor; William R. Marr, PFI forest mensurationist; Patrick W. Pendell, PFI forester; Guy C. Grahma, PFI inventory forester; and James C. Billington, PFI forest engineer. In addition, the author, as coordinator of this project, is grateful to many other people--in the forest, the office, and the laboratory--whose ideas and dedicated work contributed to the project's encouraging progress. Our Committee also greatly appreciates the financial support from Boyce Thompson Institute, Potlatch Forests, Inc., and the Idaho State Land Board's approval of grants from the cooperative forest pest abatement fund.

SUMMARY

The project began in 1965 with a gratis investigation of the problem by Boyce Thompson Institute for Plant Research (BTI)* at the request of the Bark Beetle Committee of the Montana-Northern Idaho Forest Pest Action Council. The principal instigator of the research, Potlatch Forests, Inc. (PFI), invited BTI to study the problem on its timberlands in the vicinity of Headquarters, Idaho. This preliminary study established the seriousness of the infestation, estimated to have been killing at least 200,000,000 board feet of white pine annually on all timberland ownerships in Idaho and Montana (enough lumber for 20,000 homes). The study also indicated the possibility of utilizing an attractant odor produced naturally by the female beetle as a potential control device to replace previous unsuccessful attempts to control the beetle by direct methods (logging and/or chemical spraying of infested trees). As a result, cooperative agreements were

*Main laboratory located in Yonkers, New York; field laboratories in Grass Valley, California and Beaumont, Texas.

developed involving separate contracts between BTI and PFI, and BTI and the State of Idaho.

During the ensuing five years, thousands of man-hours and several hundred thousand dollars have been spent on extremely complex research. The principal direct financial sponsors have been BTI and PFI, with other private forest land owners and the State of Idaho contributing through a special forest pest abatement fund previously established under state law and administered by the Idaho State Land Board. Briefly, the results are as follows:

1965-66--BTI scientists confirmed the existence of the insect-produced pheromone and determined it to be a highly volatile substance concentrated in minute but potent quantities in the fecal pellets and hindguts of only female beetles.

1967-68--Analysis of more than 20,000 female beetle hindguts by BTI and Battelle Memorial Institute (under subcontract to BTI) resulted in the isolation, identification and chemical synthesis of several candidate attractive compounds. Forest tests clearly established that trans-verbenol (a terpene compound isolated from the female beetles) and alpha pinene (a constituent of the resin from white pine) are the principal compounds stimulating the aggregation of mountain pine beetles.

1969--Forest tests conclusively established that large numbers of naturally-emerged, flying beetles can be induced to mass-attack live white pines baited with trans-verbenol plus alpha pinene, with relatively few attacks occurring on unbaited pines in the vicinity. An attempt to protect baited trees by spraying the boles to a height of 20 feet was only partially successful. A preliminary, small-scale forest test indicated that large numbers of flying beetles can be attracted to and trapped by simulated trees (10"x8' paperboard cylinders) coated with a sticky substance and baited with the attractant mixture.

1970--Expanded tests on 1920 acres of PFI Idaho timberlands produced these specific results: 1--Confirmed the effectiveness of the attractant in concentrating thousands of beetles on baited live white pines; however, the reduction of attacks on non-baited trees was less than anticipated. 2--Indicated that the effective attractant range of present synthetic pheromones is probably limited to not more than 200 to 300 feet. 3--Indicated the potential effectiveness of baited sticky traps to lure beetles away from live white pines, with a 50% reduction in the number of mass attacked trees on the two 40-acre plots treated. At least part of the reduction can be attributed to the traps. 4--Identified several additional synthetic compounds having potential for increasing attractiveness. 5--Confirmed the potential practicability of large-scale positive color air photo transparencies as a supplemental tool in surveying the effectiveness of beetle control efforts.

Of special significance is the fact that the cost of synthetic trans-verbenol has been reduced from $800 per ounce for the first five ounces of material produced experimentally in 1969 to approximately $10 per ounce for the material now being used.

1971 plans--Although we do not yet claim the development of a proven beetle

control technique over large areas, results of our 1970 project give continued encouragement. We were disappointed in the apparently limited range of the present attractants; this means that the baited targets must be spaced much more closely than we had hoped. Nevertheless, in 1971 an effort to initiate control of the mountain pine beetle will be undertaken on 4000 acres of PFI white pine stands, utilizing traps consisting of 1'x4' plywood panels coated with the sticky compound and baited with trans-verbenol plus alpha pinene. The State of Idaho has expressed interest in possibly treating adjacent stands. The objective is to reduce the beetle infestation from epidemic level (exceeding 4% annual white pine mortality) to an endemic level (less than 1%). Based on present knowledge, we are hopeful this objective may be accomplished with two to three successive years of baiting.

In addition, research will be continued on: 1--Testing of additional beetle and host tree compounds for increased attractiveness and more effective and less costly manipulation of flying beetle populations. 2--Determination of the most effective spacing of traps in the forest. 3--Testing of various types of traps and compounds to develop more efficient beetle extermination. 4--Testing the effectiveness of evenly-spaced traps as compared to baiting live trees in small blocks. 5--Expansion of the application of color air photos as a survey tool.

1970 PROJECT

The goal of the overall project is to develop a control method whereby snythetic attractants can be used to suppress a mountain pine beetle infestation in white pine to tolerable economic levels.

The principal study area was the same as in 1969--typical beetle infested and blister rust infected mature (140 yrs.+) white pine-mixed type on PFI lands in the Lightning Point area 10 miles northwest of Headquarters, Idaho. The 1970 project again consisted of two phases. Phase I dealt with research on the fundamental aspects of pest manipulation in an effort to refine existing techniques and develop new knowledge. Phase II was limited to a pilot-scale application of the most effective techniques developed previously.

Phase I

Objectives:

The principal objectives of Phase I were: 1--To continue the isolation, identification, synthesis, and bioassaying of candidate attractant compounds for the mountain pine beetle. 2--To develop a longer-lasting dissemination system for the controlled release of attractants in the forest. 3--To develop more effective and longer-lasting adhesive coatings for beetle traps. 4--To determine feasibility of attracting beetles to sticky traps as compared to baited live trees, and to develop the most efficient design of such devices. 5--To test effects of baiting live white pine on 100' and 200' contours. 6--To test the efficiency of

attracting beetles to nonhost trees baited with pheromone and treated with Stikem. 7--To assess the accuracy of colored aerial photos for detection and evaluation of mountain pine beetle infestations. The forest phases of objectives 4 - 6 were conducted in eight specially selected 40-acre plots.

1. Isolation, identification and synthesis of candidate attractants: Eighteen compounds were produced by Union Carbide Company, South Charleston, West Virginia. These were bioassayed with olfactometers placed in the forest edge around the log decks at PFI's Jaype mill near Headquarters, Idaho. Several of these compounds showed promise in either being more attractive than the standard trans-verbenol-alpha pinene mixture or in luring a more favorable ratio of female to male beetles. These will be further tested in 1971.

2. Developing a more persistent disseminating system: Battelle Memorial Institute, Columbus, Ohio, was retained to conduct detailed laboratory studies of the various factors affecting the diffusion rate of trans-verbenol through thin-wall polyethylene tubing, i.e., tubing wall thickness, temperature, percent load of attractant, duration of exposure. Results indicated that PE-205 tubing loaded with neat trans-verbenol should provide adequate dissemination over two to three seasons. This tubing has an inside diameter of 0.062", an outside diameter of 0.082", a wall thickness of 0.010", and a load capacity of 1.174 lbs. of trans-verbenol per 1000'.

Battelle Memorial Institute also conducted studies of various polyethylene containers for disseminating the alpha pinene component of the attractant. (Note: For the first large-scale test of the attractant mixture in 1969, both the trans-verbenol and alpha pinene were loaded in the same tubing. However, this proved unsatisfactory because the alpha pinene evaporated too rapidly.) Results indicated that a two-ounce polyethylene bottle filled with alpha pinene should serve for two to three seasons.

Forest tests of these and other attractant disseminating systems will be made in 1971.

3. Developing more effective trap adhesives: Our limited 1969 test of sticky traps showed that the standard formulation of Stikem Special lost its capacity to hold beetles within a few weeks after exposure to Idaho's forest climate. Consequently, Battelle Memorial Institute was asked to attempt to develop a more effective material. Several different formulations of water emulsified vinyl acrylate were prepared. These were tested under forest conditions in Idaho and California and proved to be effective in trapping flies and moths but not bark beetles. Later tests of Stikem with various additives developed a formulation which appears to be more satisfactory. See page 7 for more detail.

4. Attracting beetles to sticky devices--procedure and results: Preliminary tests in 1969 indicated that mountain pine beetles could be attracted to sticky

traps such as 12"x60" paperboard cylinders coated with Stikem Special (manufactured by Michel & Pelton, Emeryville, California) and baited with trans-verbenol and alpha pinene. In 1970 the experiment was expanded to test such devices on a forty-acre basis for effects on the current year's tree mortality. Since the cylinders were bulky and cumbersome, plywood panels coated with Stikem and baited with pheromone were also tested concurrently.

Two forties in the Lightning Point area were selected and each forty was alternately baited with 12"x65" cylinders and 12"x48" panels on 100' contours in groups of 5 at 200' intervals. The traps were placed vertically on 2"x2" wooden stakes with the lower end of the trap about 18" above ground level. Brood conditions from 1969 mass attacks were somewhat similar for both forties, with 49 trees in one and 38 in the second. After the initial flight, the traps were examined and very little difference could be seen between the numbers responding to panels or to the cylinders.

In terms of effect on 1970 beetle activity, Table 1 illustrates the comparison between forties treated with traps and those in which only trees were baited. With 1376 sq. ft. of trap surface, a 51% reduction was noted in 1970 tree mortality. Cause-effect relationships are definitely not established by these results, but they are suggestive of a degree of beetle control, especially in view of the other treatments where the level of the infestation remained nearly constant or showed a sharp increase in 1970. The precise treatment in the three forties where trees were baited is described in a later section. Briefly, mature white pine were baited on either 100' or 200' contours at intervals of 200'.

Table 1. Comparison of Dendroctonus ponderosae activity in forties where pheromone was deployed on sticky traps or mature white pine.

No. 40's Treated	No. W.P. trees baited 1969	No. baited 1970		W.P. Mortality		Magnitude of infestation change from 1969
		Traps	Trees	1969	1970	
2	195	172	-	87	43	- .49
1	95	-	55	78	82	+1.05
1	99	-	79	32	68	+2.12
1	-	-	75	28	93	+3.32

A concurrent test was conducted to test the efficiency of the two basic trap designs. Cylinders of three different sizes, 3"x43", 9"x65" and 12"x65", were compared against 12"x48" plywood panels. This was a duplicated experiment with one group of cylinders and two sets of panels at each site. Each trap was baited with 8 ft. of attractive polyethylene tubing and 2 Boston round bottles with 10 ml alpha pinene. Each panel was sealed, prior to coating with Stikem, with a clear synthetic resin (Rez, sold by Rez-Wood-Tones, Inc., Torrance, Calif., $6.25/gal.).

During a 55-day period the 8 sets of traps caught 10,544 D. ponderosae. The breakdown on capture for each trapping device is shown in Table 2. The plywood panels were slightly superior to the larger cylinders in terms of percent of catch, numbers/sq. in. trap surface, and male:female sex ratio. However, their main advantages were the ease of coating with Stikem and transportation and deployment in the forest, i.e., the two forties baited with 12"x65" cylinders and panels required 22 man-days for placing the cylinders and only 11 man-days for the panels.

Table 2. Trap design and its effect on trapping in-flight Dendroctonus ponderosae. Each trap was baited with 8 ft. of polyethylene tubing charged with trans-verbenol and two 5 oz. plastic bottles containing alpha pinene, and coated with Stikem Special. Duration of the test was 55 days.

Trap	Total response[1/]	% of capture	No. beetles/sq.in. trap surface	Sex ratio male:female
Cylinders:				
3" x 43"	1,211	11.5	1.49	1:0.9
9" x 65"	2,371	22.5	.65	1:2.5
12" x 65"	3,228	30.6	1.39	1:1.1
Plywood panels:				
12" x 48"	3,734	35.4	1.62	1:2.7
Total	10,544	100.0		

1/ Test was duplicated in different areas. Totals represent composite of data.

Discussion:

Measuring the effectiveness of control was difficult because of the lack of precise data on previous beetle population trends in the experimental area. Nevertheless, a reasonable assumption is that some control was effected because many of the panels and cylinders captured hundreds, and in some cases thousands, of mountain pine beetles. Again, discussion of cause-effects such as relationship between trap area and percent reduction of tree mortality becomes tenuous. At best we have an indication that deadtrapping may be an effective approach to regulating mountain pine beetle with attractants. However, these results cannot be considered conclusive because: 1--We cannot claim that trapping some "X" amount of beetles was responsible for the reduction in 1970 tree depredation; there is a possibility that the population trend in 1970 was down in these two forties on which live trees were baited in 1969. 2--We cannot yet assume that we can duplicate experimentally all the multitudes of stimuli that must be operative during the initial and later stages of host colonization. Competitiveness is the key to biological success of manipulating an in-flight pest population. The more reliable system would seem to be to bait living trees in blocks of one to five acres, and then salvage or chemically treat the infested timber prior to emergence and flight.

This approach may be more consistent with the biology and economics of pest regulation. Similar procedures have produced outstanding success in southern pine and Douglas fir.

A 1970 tally of 1969 brood trees made in the two forties baited with traps exceeded the count made in 1969 by 40 trees. There are several plausible explanations for this discrepancy. First, due to limited availability of attractant in 1969, the polyethylene tubing was charged with a minimal amount of material. At 24 mg trans-verbenol per foot of tubing, which was the amount used in 1969, the percent load of tubing was only 13.8. This amount gives an acceptable rate of evaporation (14 - 25 μg/hr/ft) for only about 30 days, not long enough to affect the second flight in 1969 which occurred from 70 to 80 days after the spring flight. The magnitude of this second flight was much greater than anticipated and, undoubtedly, contributed significantly to that year's tree mortality. By comparison the 1970 tubing was charged with 147 mg trans-verbenol/ft., or 84.4% of full load; with certain assumptions regarding temperature, this percent load will still be delivering trans-verbenol in excess of 17 μg/hr/ft. after 5 months, and hence should be much more effective in attracting the second flight.

A second reason for the discrepancy is the fact that the 1969 tally of brood trees was made after the spring flight but before the second flight; hence, some 1969 mass attacks not recorded in 1969 were found during the early 1970 examination.

A third factor which may have contributed to the discrepancy was human judgment. Differentiation of current losses from last year's mortality is relatively easy; however, separating last year's kill from the preceding year's is exceedingly difficult--in fact impossible under certain conditions. Hence, there is a strong possibility that the 1970 tally of 1969 mortality included some trees from 1968. This potential error will be eliminated on several forties in the 1971 study because all 1969 and 1970 brood trees have been paint marked.

Concerning the sticky plywood panels as future trapping devices, it is imperative that the plywood panels be treated with a sealer prior to coating with Stikem. If not sealed, the Stikem is soon absorbed by the panels to the point where they are no longer effective in immobilizing the responding beetles. While Stikem is basically an excellent product, its principal deficiency is its inability to withstand the spring weather of northern Idaho. After repeated exposures to rain and snow, the surface of the Stikem seems to form an emulsion with the water which noticeably reduces the tackiness of the material. Seven different formulations of Stikem with waterproofing and antioxidizing agents have been field tested in Grass Valley for several months. The control Stikem alone lost much of its tackiness after a few weeks, as have some of the other formulations. Stikem with the waterproofing agent has held up much more satisfactorily and will be the material used for the 1971 project.

5. Baiting white pine on 100' and 200' contours--procedure and results: During the field studies in 1969 eight 40-acre plots were systematically baited by selecting mature white pine on a grid pattern of 2 chains (132'). After the first flight in early June, it was evident that the normal attack pattern was being altered, i.e., of 154 mass attacked trees, 133 were baited trees. Considerable

time and effort was consumed with this close spacing of tree traps. Therefore, in 1970, the pattern was altered in the interest of economy and trees were baited in groups of 1 - 6 at 200 ft. intervals along 100' and 200' contours.

Two contiguous forties in the Lightning Point area were selected for baiting. In one, 75 trees were treated with attractive tubing along two 100' contours. They were all mass attacked, with an additional 20 unbaited trees being killed in scattered portions of the forty. In the second forty, 55 trees were baited along a single contour. Again 100% of the trees were mass attacked and killed; 27 additional unbaited trees throughout the forty were also mass attacked. The distance from pheromone to mass attacked unbaited trees was determined in both forties. No significant difference could be detected between the forties, for the percent of mass attacked trees within 1 chain of baited trees was 40% for two 100' contours and 45.5% for the single contour.

Discussion:

From the available data, it is not possible to illustrate distinct differences in effects on attack patterns between the two forties. The potential brood in the forty baited on the single contour was about 3 times greater than in the forty baited on the two 100' contours. Therefore, these data suggest that baiting on one contour was at least as effective as baiting on two contours; however, additional research would be required to confirm or refute this conclusion.

There are certain inherent deficiencies in the technique of baiting on contours. The spacing of pheromone is strictly dependent upon terrain, i.e., the steeper the slope, the closer are the lines. It can be expected that at 200' contours, as well as 100', considerable areas within a forty may go untreated. The range of effectiveness of present synthetics in attracting beetles is not extensive and little influence can be expected on the attack pattern outside of 3 to 5 chains.

An advantage of contour baiting would appear to be the ease of pheromone placement, although this is subject to argument. In the final analysis, grid baiting may be the most economically as well as biologically practical.

6. Effect of baiting nonhost trees--procedure and results: In two forties, groups of 4 to 6 nonhost trees at 200' intervals on 100' contours were wrapped to a height of about 6' with paperboard precoated with Stikem and then baited with trans-verbenol and alpha pinene. After the first flight, one forty was given a 100% cruise and all 1970 and 1969 white pine mortality was recorded.

Approximately 131 grand fir, red cedar and white pine snags were baited and treated with Stikem-paper. An assessment on the efficiency of these traps to attract mountain pine beetle was made during midsummer. Five groups of trees, containing 5 trees each, were selected and samples 1' square were taken at the top of the trap and in the middle and bottom areas. All bark beetles and predators were counted. The samples were somewhat biased since only areas that contained beetles were selected. From 75 samples, 164 mountain pine

beetles were counted, or 2.2/sample. The clerid* catch was low. The remainder of the traps were casually examined and, in general, reflected the low response to the traps of the more carefully sampled group. *Beetle predator insect.

The 100% cruise of the one forty suggested a marked drop in 1970 mountain pine beetle activity. In 1969, 21 trees were mass attacked; however, as discussed previously, some 1968 trees may have been mistakenly included in the tally. The 1970 activity was down to 8 trees. No cruise was made in the adjacent forty.

Plywood panels treated with Stikem and pheromone were nailed horizontally to two sides of a few nonhost trees. These traps attracted beetles but the test was not extensive enough to assess the efficiency of the technique.

Discussion:

The relatively small number of D. ponderosae entrapped on the Stikem-paper was disappointing. While cause-effect relationships cannot be definitely established, there are two possible explanations which seem logical. (1) The trapping devices were not placed until May 26-28, two weeks after the first major D.p. emergence and a few days after the beginning of the peak emergence which occurred the last week in May and the first week in June. Obviously, the nonhost traps were not placed soon enough to be effective against the first beetle emergence which probably resulted in some partial attacks on live pine, thus initiating a strong competition against the synthetic attractant. (2) The 100% cruise of the one forty showed a decline in beetle activity in 1970 as compared to 1969. This indicates one of two possibilities: (a) The 1970 beetle population was relatively low in this forty, or (b) many of the beetles were attracted out of this forty into adjacent forties baited earlier with live trees or bogus tree traps.

Additional tests are warranted to determine if nonhost odors serve as an antagonist to the pheromone, or if the technique itself is in some way physically incorrect. One very obvious difficulty was the actual wrapping of the trees with the paper. Limbs, irregularities of the stem, width of the paper, and separation of the plastic coating from the paper all contributed to the large amount of time it took to bait the two forties. Additional testing of this technique may be warranted using narrower strips of nonplastic coated paper--not more than 1' wide as compared to the 3' width used last year. If this technique could be made effective, it should greatly reduce the time and cost of back-packing and placing the much heavier plywood panels and supporting stakes.

There should also be further testing of plywood panels nailed to nonhost trees and snags. If effective, this would eliminate the cost of and time required to place the stakes.

7. Test of aerial photo transparencies

Purpose--A test of large-scale positive color transparencies was initiated on two of the 40-acre plots of Phase I. The purpose was to determine the feasibility of such photography for tree mortality detection and survey of the effectiveness of beetle control efforts. Normal ground surveys are extremely time-consuming, and hence costly, in the white pine type because of stand density, tree height and rough terrain. A more efficient method than ground surveys is urgently needed.

Procedure--Photos were taken on July 9 on Eastman Ektachrome MS Aerographic Film, Type 2445, with a 12" focal length camera. Three photo scales were exposed--1"=500', 1"=200', and 1"=80' (approximately). Photos were evaluated in the forest, using a portable light table, to simultaneously compare the photoimages of trees with ground observations of the same tree.

Results--Briefly, the scale approximating 1"=80' proved the most practical. This scale varied from 1"=75' to 1"=120' because of variations in ground elevation. A scale of 1"=100' seems to be the best for differentiation of species, blister-rusted white pines and white pines killed by bark beetles. The smaller scales appear to be impractical because of interpretation problems. (More details of this study are available upon request.)

Previous studies of infrared color reversal film have shown no advantage over positive color for our problem. Also, to our knowledge, nobody has yet developed a remote sensing technique to consistently identify mountain pine beetle brood trees in white pine before crown fading is apparent to either the naked eye or film, which requires from several months to a year after beetle attack. Hence, air photos have the disadvantage of delayed identification as compared to ground surveys.

Phase II

Objectives:

Phase II was an expanded pilot-scale test of the synthetic attractants involving the baiting of live white pines on 1600 acres of PFI stands in which there had been no previous beetle control effort. The objectives were to: 1--Test the effectiveness of the attractant in concentrating naturally-emerged flying beetle populations on baited live trees; 2--Assess the physical and technical problems involved in carrying out the system on larger areas; 3--Develop guidelines on material, equipment and labor costs.

Because of unforeseen difficulties, not as much area could be treated under Phase II as was planned. The spring truckers' strike delayed delivery of some of the attractant material by four weeks, which in turn delayed the beginning of the baiting operation. Also, the first significant emergence and flight of beetles occurred during the second week of May, about four weeks earlier than ever recorded previously since the inception of this research. Another, and the major peak flight, occurred during the last week of May and the first week of June. Consequently, the decision was made to stop baiting on June 4, with only 1600 acres completed of the 4000 acres planned.

Procedure:

1. Contour lines on 100' intervals were Abney-surveyed on the project area and identified with code numbers painted on trees. The approximate locations of contours surveyed were drawn on a 5"=1 mile planemetric map as work progressed.

2. White pines were baited on or near the contour lines in groups of 1 to 5 (depending on d.b.h.) with the same attractant materials described in Phase I. A total of 2412 pines were baited in 895 groups on the 1600 acres for an average of 2.7 trees per group and 1.5 trees per acre.

3. Baited pines were left untreated otherwise (not protected with Lindane

as in 1969) to provide a better assessment of the effectiveness of the attractant in concentrating beetle populations on the target trees.

4--In December, 1970, five 40-acre blocks were intensively surveyed to obtain a sample of the effectiveness of the attractant. On each of the five 40's, all white pine trees were closely examined and recorded as follows: a--Baited, mass-attacked in 1970; b--Baited, moderate-attacked in 1970; c--Baited, not attacked; d--Not baited, mass-attacked in 1970; e--Not baited, moderate-attacked in 1970; f--Not baited, mass-attacked in 1969; g--Not baited, moderate-attacked in 1969; h--Not baited, not attacked. The approximate location of each baited-tree plot was identified by a rough circle and plot number on a 1"=132' map. All beetle-attacked trees, both inside and outside the baited plots, were paint-marked with a serial number, and their approximate locations and numbers were entered on the map. All live, unattacked white pines were marked with two orange paint-dots. (This marking system will provide positive identification for subsequent surveys.)

Results:

Results are summarized by Tables 3, 4, and 5 on pages 12 and 13.

The significant results revealed by Table 3 are:

1. Baited trees, 1970 attacks (Columns 13-17): Of the total 368 pines baited, 93 or 25.3% were mass-attacked (more than 100 attacks per tree), 45 or 12.2% were moderate-attacked (fewer than 100), and 230 or 62.5% had no attacks. A mass attack is considered lethal to the tree; the moderate attack is non-lethal by itself.

2. Unbaited, 1970 attacks (Cols. 8-12): Of the total of 5927 unbaited live white pines on the five 40's in the spring of 1970 (prior to beetle flight), 137 or 2.3% were mass-attacked during the 1970 flight, 22 or 0.4% were moderate-attacked, and 5768 or 97.3% were not attacked.

3. 1969 attacks (Cols. 3-7): An attempt was made to identify all 1969 mass and moderate attacks which occurred in the sample 40's to determine the recent trend of bark beetle activity. The 1969 attacks were also recorded and mapped. While positive differentiation of 1969 attacks from 1968 attacks and early 1970 attacks was impossible, the data as recorded is as follows: Of the total of 6588 live white pines on the five 40's in the spring of 1969, 292 or 4.4% were mass-attacked in 1969, 1 tree or -0.1% was moderate-attacked, and 6295 or 95.6% were not attacked.

4. The distances of the 1970 attacked unbaited pines from the nearest baited trees were not actually measured on the ground in this survey; rather, the distances were scaled from the 1"=132' field maps on which all attacked pines were plotted. This data is summarized by Table 4, which shows that the distances ranged from only a few feet to a maximum of 9.5 chains or approximately 600 feet. The average weighted distance was 2.1 chains or approximately 140 feet.

Table 3. Effect of baiting live white pines with trans-verbenol and alpha pinene on five 40-acre sample blocks within the Phase II area of 1600 acres. Based on a 100% cruise of white pine in December, 1970. Data in numbers of white pine trees.

	Stand as of 1969						Stand as of 1970											
	All Unbaited Trees						Unbaited Trees					Baited Trees					Total Trees				
Sec.	40 #	Mass Atk.	Mod. Atk.	SubT. Atk.	# Atk.	Total Trees	Mass Atk.	Mod. Atk.	SubT. Atk.	No. Atk.	Total Trees	Mass Atk.	Mod. Atk.	SubT. Atk.	No. Atk.	Total Trees	Mass Atk.	Mod. Atk.	SubT. Atk.	No. Atk.	Total Trees
(1)	(2)	(3)	+ (4)	= (5)	+ (6)	= (7)	(8)	+ (9)	= (10)	+ (11)	= (12)	(13)	+ (14)	= (15)	+ (16)	= (17)	(18)	+ (19)	= (20)	+ (21)	= (22)
11	3	5	0	5	206	211	2	0	2	177	179	2	0	2	25	27	4	0	4	202	206
11	12	23	0	23	697	720	11	2	13	645	658	12	6	18	21	39	23	8	31	666	697
11	16	78	0	78	1537	1615	40	8	48	1355	1403	43	17	60	74	134	83	25	108	1429	1537
13	6	95	0	95	1571	1666	44	5	49	1458	1507	16	8	24	40	64	60	13	73	1498	1571
14	1	91	1	92	2284	2376	40	7	47	2133	2180	20	14	34	70	104	60	21	81	2203	2284
Total 200A.		292	1	293	6295	6588	137	22	159	5768	5927	93	45	138	230	368	230	67	297	5998	6295
Ave/A.		1.5	-	1.5	31.5	33.0	0.7	0.1	0.8	28.8	29.6	0.5	0.2	0.7	1.1	1.8	1.2	0.3	1.5	29.9	31.4
% by Treatmt.		4.4	-	4.4	95.6	100.0	2.3	0.4	2.7	97.3	100.0	25.3	12.2	37.5	62.5	100.0	3.6	1.1	4.7	95.3	100.0
% Tot. Stand		4.4	-	4.4	95.6	100.0	2.1	0.4	2.5	91.6	94.1	1.5	0.7	2.2	3.7	5.9	3.6	1.1	4.7	95.3	100.0

R.G.C. 3/26/71

Table 4. Numbers of unbaited white pines attacked in 1970 listed by distances to nearest baited tree, on five sample 40's. (8 trees unaccounted for.)

	Horizontal Distances in Nearest Chain										
No. of Trees	Less than 0.5	1	2	3	4	5	6	7	8	9	Total
Mass Attacked	17	50	28	10	5	12	6	1	0	1	130
Mod. Attacked	3	6	3	6	1	1	1	0	0	0	21
	20	56	31	16	6	13	7	1	0	1	151

Weighted Averages:
Mass = 2.1 chains = 139'
Moderate = 2.2 chains = 145'
Average = 2.1 chains = 139'

Table 5. Numbers of baited pine plots by distances between plots on contour and between contours, from samples measured on map.

	Horizontal Distances in Nearest Chain											
No. of Plots	1	2	3	4	5	6	7	8	9	10	11	Total
On Contours	12	48	32	6	2	0	0	0	0	0	0	100
Between Contours	16	23	22	20	4	1	1	2	1	0	1	91

Weighted Averages:
On Contours = 2.4 chains = 158'
Between Contours = 3.0 chains = 198'

The distances between baited tree plots on the contours and between contours on the 5 sample 40's were determined by a representative sample of measurements on the 1"=132' field maps. The results are summarized in Table 5. The range of distances between plots on the contours was from approximately 1 chain (66') to 5.5 chains or 363', with a weighted average of 2.4 chains or 158'. The range of distances between contours was from approximately 1 chain or 66' to 11.5 chains or 759', with a weighted average of 3.0 chains or 198'.

Discussion:

On the surface, these results are disappointing. Comparing the numbers of baited white pines mass-attacked with those not attacked and with the number of unbaited pines mass-attacked would appear to indicate that the attractant did not perform as well as anticipated. The reasons for this disappointing data are not fully apparent, but several possibilities exist, i.e.:

1. There is a strong probability that many of the 1970 mass attacks were at least initiated prior to the completion of the baiting operation. Observations indicate that even a moderately attacked tree creates a more attractive target to free-flying beetles than does a tree baited with the present pheromone compounds. For reasons previously stated, the baiting program could not be started until April 13 and it was terminated on June 4. The first major beetle flight occurred during the second week of May, with the major spring peak during the last week of May to June 5 when cool, rainy weather halted the flight. Obviously, many beetles were flying in at least part of the 1600 acres prior to the full force of the synthetic attractant. This points up a key requirement--the placing of attractant targets well in advance of anticipated beetle emergence.

2. Observations in the study area over the last several years have recorded the fact that pines subjected to non-lethal (light and moderate) attacks during the fall beetle flight in one year are usually the first trees mass-attacked the next year by the early-emerging beetles. Therefore, the 1969 partially-attacked pines probably offered the greatest competition to the synthetic attractant in the spring of 1970. This speculation is supported by the data for the five sample forties recorded in Table 3 which lists only one 1969 moderate attack, whereas there was a total of 22 moderate attacks on the unbaited and 45 on the baited pines in 1970. This leads to the logical conclusion that greater trapping success could be achieved if the attractant targets (baited trees or traps) were located close to current brood trees wherever practicable. This will be tested in 1971.

3. The spacing of baited plots may have been too great to accomplish the desired degree of concentration of attacking beetles on baited pines, e.g., results were not nearly as effective (following the first peak beetle flight) as in the 1969 test area where single baited trees were spaced on a 2-chain or 132' grid. Actual slope distances on the ground are, of course, somewhat greater than the horizontal distances recorded in Table 3, especially on the steeper hillsides. However, Table 5 indicates that in 1970 the average distance between baited tree plots was 158' on the contours and 198' between contours, with an overall average of 178' or 46' more than in the 1969 grid of 132'. While this small difference may have been significant in the relative attraction of beetles, it seems more logical to conclude that--

4. The relative irregular spacing of baited plots on the contour may not be as effective as grid spacing. While the <u>average</u> distance between plots baited in the 1970 contour system was only 46' greater than in the 1969 grid system, the average figure is misleading, i.e., Table 5 shows 33% of the plots were 4 chains (264') or more apart between contours. Also, examination of the field maps reveal some large "holes" in the 1970 baiting pattern.

5. The large population of beetles may have been too overpowering for the synthetic attractant. However, this would seem to be refuted by the fact that such a large number of baited trees (230 or 62.5% in the sample area) were not attacked at all, which leads to the more logical conclusion that many of the beetles may have diverted to attack unbaited trees, or 1969 partially-attacked trees as mentioned previously, before they reached baited trees. On the other hand, previous and concurrent olfactometer tests consistently indicate that the synthetic attractant is highly competitive with natural sources (<u>D.p.</u> infested log sections) at equal

distances. This problem of the most efficient baiting pattern will be researched further in 1971.

6. Unavoidable errors were made in classifying the year of beetle attacks on the trees in the sample forties. As previously mentioned, this is extremely difficult unless done concurrently with or soon after attack. Unfortunately, manpower limitations delayed the sampling survey until mid-December, by which time the precise differentiation between all trees attacked late in 1969 and early in 1970 was impossible. Consequently, there is a strong probability that some late 1969 attacks on unbaited trees were mistakenly recorded as 1970 attacks. This problem will be alleviated next year on the five 40-acre sample blocks because all attacked trees have been identified and paint marked. However, this will not solve the problem of sampling on the much larger area (4,000 acres) planned for a control attempt in 1971. This is the reason why an expanded test of large-scale air color photos is planned, as discussed elsewhere.

In spite of the disappointments and problems mentioned above, the 1970 pilot test did produce some positive indications, i.e.:

1. The beetles had a much greater opportunity to attack unbaited trees than baited, yet Table 3 shows that 25.3% of the baited pines (Column 13) were mass-attacked in 1970, whereas only 2.3% of the unbaited trees (Col. 8) were mass-attacked. Also, 12.2% of the baited trees (Col. 14) were moderately-attacked, as compared to only 0.4% for the unbaited (Col. 9). This clearly indicates that the attractant was a partial success, especially in view of the fact that there was a much larger number of unbaited trees (5927) than baited (368).

2. Table 3 also shows that the level of mass attack in the unbaited stand in 1969 was 4.4% of the total number of pines (Col. 3), whereas in 1970 after the stand was baited the mass attacks on unbaited trees was only 2.3% (Col. 8)--a reduction of 2.1%. However, the total level of beetle activity remained nearly the same, as indicated by the 1970 attack figures for baited and unbaited trees combined, i.e., mass-attacked = 3.6%, moderately-attacked = 1.1%, total attacks = 4.7% (Colums 18, 19 and 20).

3. In studying Table 4, it must be kept in mind that the mountain pine beetle prefers to attack the larger white pine trees. In these mature stands there are few of these larger trees within 0.5 chain of each other, which makes the 1 and 2 chain distances much more significant. Also, the data suggests that 95 or 73% of the 130 unbaited mass-attacked trees (horizontal distances 0.5 through 2 chains) were under the influence of a baited tree, as evidenced by the fact that above 2 chains the number of mass attacks drops off sharply.

Costs

Total money spent on the project through 1970, and the sources of funds, is summarized below:

Source of Funds	Amount by Years 1966	1967	1968	1969	1970	Total
Boyce Thompson Institute[1]	Approx. $50,000	$77,000	$63,000	$32,000	$22,000	$244,000
Potlatch Forests, Inc.	5,000	15,000	12,000	22,000	29,000	83,000
Idaho Forest Mgmt. Fund[2]	none	20,000	25,000	25,000	35,000	105,000
Total	$55,000	$112,000	$100,000	$79,000	$86,000	$432,000

(1) Includes funds from the Boyce Thompson Institute and grants to the Institute from the U. S. Public Health Service, and the Margaret T. Biddle Foundation.
(2) A special account established by state law (Idaho Code 38-407 & 408) for cooperative forest pest abatement and control, which accumulates to a ceiling of $100,000 from 5% of monies collected by the state from timber harvest on private lands and state timber sales for logging slash disposal and fire hazard reduction. Disbursements from this fund must be approved by the Idaho State Board of Land Commissioners.

A total of $106,000 was budgeted for the 1970 project. Only $85,971 was actually spent, for several reasons. Not as much acreage was baited in Phase II as planned. Also, we felled and sprayed infested bait trees on only one forty-acre plot not salvage-logged instead of the much larger acreage originally planned because we decided to substitute the placement of sticky traps in 1971 when this technique proved encouraging on the two forties tested in 1970. All Phase II costs were financed by Potlatch except for the technical assistance provided by BTI.

About $10,000 more was actually spent on Phase I than originally budgeted, for several reasons. First, the test of large-scale color aerial photos was added after initial plans were made. Second, the actual expense of some items was higher than estimated, e.g., fabrication and placement of bogus tree traps, and tubing and bottles for the attractant. Third, much more time was spent on surveying and analysis of results than was anticipated. Fourth, heavy windthrow caused by several storms required many man-days opening roads into and through the test area. A pro rata share of this cost was charged to Phase I. All of these extra Phase I costs, except $250 of the aerial photos, were underwritten by Potlatch through transfer of budgeted but unused Phase II funds.

See next page for recap of 1970 costs.

Actual costs of the 1970 project are recapped as follows:

Item	Fund Source	$ Spent
1. Overall direction, Grass Valley Lab., technical field staff, Phases I & II	B.T.I.	$22,000
2. Phase I (Basic & Developmental research)		
a. Forest tests as listed under "Objectives" on p.3. Also, subcontract to Battelle Memorial Institute to develop new attractant compounds and more persistent dispensing systems.	Idaho Coop Fund	35,000
b. Purchase attractant and Stikem, fabricate traps, assist with field & office work, provide transportation, provide Headquarters lab.	P.F.I.	12,316
c. Subtotal Phase I		47,316
3. Phase II (Apply accumulated knowledge to control effort on 1600 acres, Lightning Point.) Includes attractant, transportation, surveys, analysis of data, reports, administration.	P.F.I.	13,185
4. Carryover of unused attractant to 1971	P.F.I.	3,470
5. Total:		
a. Boyce Thompson Institute		$22,000
b. Idaho Coop Pest Abatement Fund		35,000
c. Potlatch Forests, Inc.		28,971
d. Total		$85,971

Comparison of some of our estimated 1970 costs for Phase II with actual is of value for estimating costs for the 1971 project. The estimated cost of the filled attractant tubing and bottles was $1.14 per acre; actual was $2.30. The higher actual cost resulted from using a larger volume of trans-verbenol per tree and higher costs of tubing and bottles. Also, the entire cost of the apparatus for filling the tubing and bottles ($586) was charged against the attractant purchased in 1970. The estimated cost of locating and baiting trees on the 4000 acres planned for treatment was $1.52 per acre; actual for the 1600 acres treated was $1.79, mainly because of underestimating the time required to do the job.

A cost of $20.25 per acre was estimated for finding, felling and spraying infested baited pines with ethylene dibromide on about 1060 acres which we anticipated could not be salvage-logged; actual cost for the one forty treated was $7.55 per acre, but this was one of the more accessible forties.

The estimated average per acre cost for the total Phase II project as originally planned was $6.51; the actual cost of the smaller acreage treated was $8.24 per acre. The overage of $1.73 per acre is accounted for as follows:

(a) The first two items mentioned above. (b) The addition of the 100% cruise of five forties to measure results. (c) The heavier-than-anticipated cost of opening roads as discussed under Phase I. (d) A much greater-than-anticipated time required to analyze and report results and costs.

PLANS FOR 1971

Following is a listing of only the broad objectives. A detailed work plan is being prepared; copies will be supplied upon request to those interested.

Phase I

New leads, improvement of existing techniques, and continuation of 1970 experiments require further effort be given to Phase I of the mountain pine beetle project.

1. Further evaluate analogs of trans-verbenol and oxidation products of alpha pinene. The goal would be to isolate additional chemical messengers which attract, repell, alter the sex ratio, or in some way affect mountain pine beetle behavior. These compounds will be supplied by Union Carbide.

2. Deploy a limited number of plywood panels with pheromone and Stikem on nonhost trees to assess their effectiveness as traps for the mountain pine beetle. The objective is to eliminate the need for stakes as supports for the plywood traps.

3. Test a limited number of nonhost trees as last year, but using narrower strips of heavy grade, uncoated paperboard pre-treated with Stikem.

4. Test low-grade trans-verbenol for activity. Union Carbide has produced trans-verbenol of about 30% purity. The anticipated cost of this low-grade material is considerably less than the $155/lb. for the 85% pure synthetic now being used.

(Note: Of special interest is the spectacular reduction in the cost of effective synthetic attractant. The first five ounces of 92% pure trans-verbenol produced experimentally by Battelle Memorial Institute for our tests in 1969 cost $800 per ounce. The charge for the 85% pure synthetic now being used--produced by Chemical Samples Co.--is only $10 per ounce. If the lower-grade compound from Union Carbide proves effective, the cost of attractant chemicals will be a minimal item in mountain pine beetle control.)

5. Establish the role of alpha pinene in the pheromone complex. The quantity of alpha pinene needed may be sharply reduced since preliminary work in 1970 suggested that alpha pinene may have an area effect.

6. Continue the large-scale aerial photo survey test, if sufficient funds can be found. Present plans are for positive-color transparencies at a scale

approximating 1"=100'. The same locations will be rephotographed for several successive years in an attempt to accurately identify the trend in individual tree mortality. Two methods of photo control are being considered: (a)--Semi-permanently marked photo centers systematically distributed over the project, and (b)--Continuous, slightly overlapping photo strips through the centers of in-line 40-acre tracts. Other photogrammetry and "remote sensing" specialists are being consulted; consequently, plans may be altered. We do not anticipate that aerial photography will replace the need for intensive ground sampling in precisely identifying the current level of beetle-induced tree mortality. However, we are hopeful a technique may be developed to measure the trend of mortality over a period of several years.

7. Further evaluate, through a closely controlled test, the effectiveness of evenly-spaced sticky traps as compared to baiting small blocks of live trees. The live-tree baiting will be located where there is a positive opportunity for salvage of brood trees by logging prior to beetle emergence.

Phase II

Phase II will be the initiation of a deliberate attempt to control the mountain pine beetle on approximately 4000 acres of PFI white pine type in the Lightning Point area. Traps consisting of two 1'x4' plywood panels coated with a waterproofed formulation of Stikem Special and baited with trans-verbenol plus alpha pinene will be tested at three different spacings, i.e., 4x4 chain grid or 25 traps per 40 acres; 3x4 chain grid or 35 traps per 40; and 3x3 chain grid or 49 traps per 40. The 4000 acres will be divided roughly into thirds for the three levels of spacing. The prescribed grid spacing will be generally adhered to, with the exception that when a 1970 mass or moderately attacked pine still containing brood is observed from the surveyed trap spot, the trap will be placed within 10 feet of the brood tree so as to offer maximum attraction to the beetles when they emerge.

In addition, the log decking yards of the Jaype mill and other locations will be ringed with plywood traps in an attempt to reduce infestation of surrounding white pines from beetles emerging from logs of brood trees in the decks.

Discussion:

With the present level of knowledge concerning synthetic attractants, a logical assumption is--as Dr. Pitman points out in his Phase I progress report--that artificial traps may not be as effective in colonizing beetles as is the baiting of live trees. From a biological standpoint, the more reliable system would seem to be the group or block baiting of live trees, followed by removal of infested trees through logging or treatment with insecticides, as Dr. Pitman suggests. In fact, this was the plan for the 1600 acres live-tree-baited in Phase II in 1970. However, this plan cannot be completely carried out because there simply isn't enough time to remove or spray all 1970 brood trees before beetle emergence, which could occur as early as mid-May 1971.

The major problem with live-tree baiting in northern Idaho is the physical difficulty of the essential follow-up of brood removal or extermination, which involves literally thousands of trees on large areas of treatment such as the area treated in 1970 and planned for 1971. Unless a large percentage of the beetle brood is eliminated, baiting live trees serves to concentrate the beetle population and even, perhaps, increase it.

Steep topography, deep snow, soft roads in the spring and fall of the year in accessible areas, and present lack of secondary roads in much of the area make salvage logging difficult and costly and in some areas impossible. The same problems also are severe obstacles to spraying the brood trees with a bark-penetrating chemical to kill the beetles. Many of the trees are attacked to a height of 100', which necessitates felling them before spraying. Chemicals and equipment must be back-packed into most of the brood trees.

For these reasons, the decision has been made to utilize baited sticky traps in the major area planned for attempted control in 1971, which includes the 1600 acres live-tree baited in 1970. However, if time, manpower and money permit, additional tests of baiting live trees in small blocks will be made in highly accessible areas where there is optimum opportunity for salvage logging.

The planned treatment under Phase II involves the placing and maintenance over a three-year period of about 3400 traps located throughout the 4000-acre test area on the grid pattern previously described.

The principal objective is to reduce beetle-caused white pine mortality from an epidemic stage (8% of stand volume annually the last two years) to an endemic stage (less than 2% annually).

> Note: The 8% figure cited above does not jibe with the lower percentages listed in columns 2 and 8 of Table 3 because the Table 3 figures are based on numbers of trees, not volume. Our survey data shows that the larger white pines are nearly always attacked by D. p.; hence the % of mortality by volume is always substantially higher than % by number.

We anticipate that at least three years of repeated baiting will be required to accomplish this objective--if the traps are as effective as assumed, i.e., about a 50% reduction in pine mortality each year. Admittedly, this is a calculated gamble because it is based on the limited 80-acre test of last year, and there is no assurance that a comparable performance will be achieved on the 4000 acres planned for treatment this year. However, we feel the time has come for a test large enough to give a clear indication of whether or not the technique warrants continued effort. If the results are not sufficiently encouraging, the project can always be terminated after the first year.

The reliance on nontoxic sticky traps rather than pesticide-treated traps is also a calculated gamble based on the assumption that the water-proofing additive to the Stikem will maintain sufficient tackiness to hold the beetles for at least one season. If the system fails, the traps will have to be re-Stikemed, which will add greatly to the cost.

We are still hopeful of developing at least a semi-biological system of exterminating trapped beetles by avoiding the use of poisonous compounds. However, if the sticky system fails, we may have to resort to spraying the traps with a persistent insecticide; in this event, the highly selective deployment of the insecticide would result in minimum exposure to humans and wildlife, so there should be no hazard.

Manpower and equipment requirements:

While the plan is to treat 4000 acres, we may have to be satisfied with a smaller acreage because the plan is contingent on three unsure factors:

1. An estimate of man-days required to place the traps which is somewhat nebulous because it is based on last year's experience of baiting only the two forties with panels and cylinders in Phase I, plus the baiting of live trees on the 1600 acres of Phase II.

2. The assumption that sufficient men and rough-terrain vehicles can be employed to cover the 4000 acres in a work period of about two months--from April 1 to May 31.

3. The assumption that the first peak flight of D. p. will not occur prior to May 31. (Last year it occurred the third week in May, about three to four weeks earlier than previously recorded during the five years of this project. This, combined with the late delivery of attractant, prevented us from baiting as large an area under Phase II as was planned.

Estimated costs:

Cost estimates in this business are difficult and risky because of the lack of sufficient prior experience. Nevertheless, estimates must be made, and they are briefly summarized as follows:

The estimated cost of the pre-fabricated, ready-to-use trap totals $4.10 each. Of this, the attractant amounts to only 71¢; the balance is for materials and labor. The total estimated cost of the 3400 traps needed for the 4000 acres is, therefore, $13,940.

The estimated cost of the labor and equipment required to transport and place the traps in the 4000 acres, plus a 10% overall administration charge, totals $35,820.

The grand total estimated cost of traps plus placement is $49,760, or an average of $12.44 per acre.

We hope these cost estimates are "in the forest". The estimate for the traps should be reasonably close, but we've had to resort to considerable speculation with respect to the manpower and equipment costs. Actual costs will be reported following completion of the project.

Justification:

While the estimated first-year per acre cost of $12.44 for this trapping technique is higher than we had hoped, it will still be more than justified if the attractant is as effective as anticipated. We are hopeful of at least reducing mortality sufficiently to recover the cost of the test.

If the first year's test is successful, the baiting will be repeated for one or more years as necessary. The cost of this repeated treatment should be substantially lower than the initial cost because the traps will already be in place; the only work necessary will be refurbishing of the Stikem and the placement of fresh attractant. Applying fresh Stikem to the traps in place poses a difficult problem, but we are working on several ideas for portable extruders to make the job more efficient.

Financing:

Boyce Thompson Institute, as in the past, will provide substantial funding and the necessary supervisory personnel and most of the equipment for Phase I. Potlatch Forests, Inc., will again provide forest laboratory facilities at Headquarters and some equipment for Phase I, plus men and transportation as necessary to assure completion of this essential research.

We are hopeful, however, of again drawing some needed financial support from other sources to supplement BTI funds for Phase I. Anyone interested in making a contribution may notify us by writing to P.O. Box 1016, Lewiston, Idaho, or by telephoning 208-799-1328.

Potlatch has again agreed to underwrite the total cost of Phase II. PFI has contracted with the Clearwater-Potlatch Timber Protective Association to employ some of their people to help with the surveying and placing of traps. PFI has also assigned several of their foresters to full- and part-time work on the project, plus a snowcat and two special rough-terrain vehicles needed to transport men and equipment beyond the end of 4-wheel drive access.

This year's project was again endorsed by the North Idaho Forestry Association. Results of the research and tests will be made available to those interested through another progress report. As in the past, an inspection trip and seminar will be held at Headquarters, Idaho, if there is sufficient interest. An announcement will be mailed about mid-August.

We still welcome suggestions, questions and constructive criticism.

Hopefully submitted,

Royce G. Cox, Chairman

P.S. Our secretary just told me that it's too bad words can't kill bark beetles, because if they did I would have exterminated the little monsters long ago.